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ABSTRACT

This paper reports the results of two semesters of experience using computer-assisted instruction (CAI) to teach topics in program evaluation to undergraduate and graduate psychology students at California State University, Long Beach. (The topics addressed are models of evaluation, evaluability assessment, needs assessment, experimental and quasi-experimental design, management information systems, roles and conflicts, and cost-based evaluation methods.) A description of the structure of the program evaluation course in which the software is used is followed by a discussion of the graphical engine, a program compiled in Turbo Pascal which drives the tutorials and is capable of presenting graphics and text, taking student responses, and providing feedback. Results are reported of three preliminary evaluations involving 22 seniors and first year graduate students. It is noted that the CAI tutorials have not yet shown evidence of superiority over a more conventional textual presentation. (GL)

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COMPUTER AIDED INSTRUCTION IN TEACHING PROGRAM EVALUATION

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This paper reports the results of two semesters of experience using computer aided instruction (CAI) to teach program evaluation to undergraduate and graduate psychology students. The purposes of the paper are to describe the CAI package, report initial results and to solicit colleagues who may wish to beta test the modules at no cost and/or contribute to the development of the modules.

Structure of the Program Evaluation Course

The first author has been teaching program evaluation at both graduate and undergraduate university levels since 1978. The present structure of the program evaluation course involves two hours of lecture and three hours of laboratory each week. In the early years of teaching the course, the first author developed a series of paper and pencil simulations of program evaluation problems which became the focus of the laboratories. In addition, students used laboratory time to work on and ask questions about semester projects involving evaluation design and practice.

Beginning in the fall of 1988, the first author began to use computer aided instruction in laboratory portion of the course. This was made possible by the implementation of a microcomputer laboratory in the psychology department equipped with 12 Zenith 80286 class computers. Prior to this semester, the first author has undertaken to complete the creation of two separate products, a computer program which would drive a graphical, interactive learning environment for students, and a set of tutorials which would cover the basic concepts of program evaluation. The first of these tasks involved converting paper and pencil simulations to a format compatible with the CAI environment and the second involved programming in Turbo Pascal, Version 3.0. This was later upgraded to Turbo Pascal, Version 5.0.

[1] The first author is responsible for the development of the CAI tutorials described in this paper including the programming and the content of the tutorials. The second author contributed significantly to the evaluation of the tutorials.

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The Graphical Engine

The graphical engine is a program compiled in Turbo Pascal which drives the tutorials. This program is capable of presenting to students graphics and text, taking student responses, and providing feedback. The graphical capabilities of the program include bargraphs, piecharts, experimental plots, crosstabulations, point plots, line graphs, and plotting of algebraic equations. The graphics appear in one or two windows on screen while text occupies a third window. The program is capable of modifying graphics based upon student input, providing students with "what-if" experiences in modifying parameters. For example, to illustrate power analysis in survey sampling, students could enter sample sizes a resultant plot of confidence levels and intervals.

The graphics are each called with one to three simple statements embedded into the text of the tutorials (see below). The principle advantage of this compiled graphics-based "engine" for the tutorials is the ease with which tutorials can be constructed. A tutorial can be written in as little as ten minutes including any of the graphics noted. This is designed to overcome two major hurdles to CAI development: the time required to write good tutorials and the difficulty of including high resolution graphics. Other advantages associated with the package no royalties on the compiled version, support for a variety of graphical devices including CGA, EGA, VGA and Hercules, compatibility with PC, XT, AT, and 386 class machines. The source code could be ported to another computing environment such as the Macintosh because Pascal is a high level language although this has not yet been undertaken.

The Tutorial Contents

The second component of the CAI modules is a set of tutorials covering the following topics in program evaluation:

-models of evaluation
-evaluability assessment
-needs assessment
-experimental and quasi-experimental design
-management information systems
-roles and conflicts
-cost-based evaluation methods

These tutorials are made available to the graphical engine in the form of ASCII text files. Graphical commands, typically one line of instruction to the graphical engine, are embedded in the tutorials and are not displayed but are interpreted by the engine. Because any word processor can produce and edit ASCII text and because the graphics are easily embedded, an instructor can use the ex-

isting tutorials, modify them to suit, or create new ones quickly.

The tutorials were developed in two general formats. One is a multiple choice format illustrated with graphics which provides students information, asks the students to make choices, and provides immediate feedback. The second format is to provide students with essay task focused on the material offered in the first format and providing students with immediate feedback in the form of a sample essay response. The second format could be accomplished with any word processor. Although the tutorials were originally conceived as being only in the first format, the limitations of multiple choice input prompted the first author to develop both types of experiences and to link them in the laboratories.

These tutorials are designed to be compatible with the textbook Program Evaluation, Methods and Case Studies by Posavac and Carey but they are general enough to be used with any evaluation text book. The tutorials have been adapted from similar tutorials used by the author for years in pencil and paper environment.

Methods

Subjects

Subjects were twenty-two seniors and first year graduate students enrolled in a program evaluation course. Nineteen were female and three were male. All subjects were psychology students at California State University, Long Beach.

Procedures

Three evaluation studies took place during the second to fourth week of the semester during hours assigned to laboratories for the course. Three different evaluation activities were carried out.

In the first study, students participated in a computer version or a pencil and paper version of the same lab exercise, focused upon measurement strategies in evaluation research. Students were divided into two groups on the basis of the last digit of social security numbers and each group was comprised of 10 S's. Students in one group received the computer tutorials while students in the comparison group received the same material in a pencil and paper format. Students completed a 20-item quiz over the measurement and also wrote an essay answer to an open-ended problem over the material. The essay responses were independently judged by two raters according to the presence/absence of 13 criteria deemed important.

For the second study, parallel forms of the same quiz regarding needs assessment were used to conduct a pretest-posttest evaluation. All students received the computer tutorials. Students were divided into two groups based upon social security number with one group receiving a 17-item multiple choice pretest while the other received only a 17-item posttest. Parallel forms were used with students in a Tuesday lab receiving Form A as a pretest with Form B as the posttest and those in the Thursday lab receiving the reverse. The 17 item multiple choice quizzes were scored for correct answers. One item on one form was dropped because of ambiguity in wording. Scores were adjusted for the number items.

For the third study, students were surveys at a point after which all had received both computer and pencil/paper laboratory exercises for their perceptions.

Results

Study 1. Interrater reliability for the scoring of the essay responses was satisfactory ($r=0.81$, $p<.001$). For each condition, the correct responses on the thirteen criteria were recorded and tested for significance. The difference was not significant ($t=0.14$, $df=18$, $p<.5$, one-

tailed). On the multiple choice quiz, the difference which favored students who did not take the pretest, was also not significant ($t=0.18$, $df=18$, $p<0.425$, one-tailed).

Study 2. There was no significant difference as a function of receiving the pretest ($t=-1.78$, $df=18$, $p=0.092$, two-tailed). There was also not a significant difference from pretest to posttest for students who received the tutorials ($t=-1.27$, $df=10$, $p=0.117$, one-tailed). However, this difference was in the expected direction and the magnitude of the difference was 36 percent of the pretest standard deviation, or an effect size of about 0.36. With the small sample, this was not significant.

Study 3. Students who had participated in both types of labs rated both on the following dimensions: clarity, helpfulness, fun, amount learned, control, ease of use, clarity of instructions, and overall rating. Only two differences were significant in t-test comparisons (two-tailed). Computer labs were rated as less controllable and as more helpful. In open-ended comments which were coded for clearly stated preferences for one lab over the other, five preferred the computers, three the pencil and paper and, thirteen did not express a clear preference.

Discussion

The results of the preliminary evaluation are mixed at best. There is no evidence that students learn more from the graphical environment compared to simple textual presentation. The pretest-posttest measure did trend in the expected direction; in fact the gain from pre to post was about 36 percent of the pretest standard deviation (a an even larger fraction of the posttest standard deviation). Students do rate the computer labs as significantly more helpful but the absence of significance for such dimensions as graphical presentation is puzzling. Students rated the computer labs as significantly less positive on the control dimension, which may be a key dimension which prevents the computer labs from being more effective.

A number of variables may have influenced the results which provide important information about the use of computer tutorials. First, the comparison group test is a rather stringent test of the CAI modules since student received the same material not only in a pencil and paper format but in the textbook and lecture. Nevertheless, to justify use, CAI should eventually show this form of superiority. Second, several students in the course expressed some degree of computer phobia ranging to extreme dislike for computers. It is likely that ratings are influenced by this anxiety about the use of computers despite the fact that the tutorials were very simple to use. Third, there were a few inevitable bugs in the tutorials which occasionally caused frustration when the text written by a student was lost by a computer, for example. Fourth, and perhaps very importantly, the computers were perceived as less controllable than the alternative lab. This was partly a function of the text display procedures which did not allow students to easily move backwards within tutorials. This perceived lack of controllability may have interacted with computer anxiety for some students to reduce the effectiveness of the CAI approach. The newer version of the Graphical Educational Environment takes a different and more flexible approach to student control of the display. Controllability is such an important dimension of human performance that maximizing this dimension probably should be a paramount goal of CAI programs. It may well be so important and interact so strongly with student learning styles that CAI will never be effective for some students.

One non-rigorous source of data is the impressions of the instructor in interacting with students about the tutorials. The tutorials are experienced as relatively easy to use by the students. There are relatively few instances of students getting "stuck" and not knowing how to proceed. The tutorials provoke good questions from the students, although this is a function of the content more than the computer display. The instructor has often been

pleasantly impressed at a question which identifies an ambiguity or complexity of the tutorials. Most of the questions received from students are of this nature, indicating that the tutorials generate a fairly high degree of comprehension and involvement from students.

On the other hand, the CAI tutorials are by their nature, relatively asocial experiences. This was especially an interesting contrast for the first author who used to teach the laboratories as a discussion group experience focused upon simulations and for the second author who had taken the course in this format. The computer labs' atmosphere of absorbed individual concentration is a striking contrast to the previous format's atmosphere of lively interested discussion.

However, one weakness of the previous format which the first author had perceived and which was an impetus for the CAI approach was uneven understanding of differing students. In a group format, there is a limit upon how much repetition can occur for students who are having difficulty with comprehension. There is not similar limit in the CAI approach since students can review as much as desired.

In sum, the CAI tutorials have not yet shown evidence of superiority to a more conventional textual presentation but this evaluation has focused efforts to improve the program upon maximizing controllability and flexibility for students. It is possible that a next generation of the program will be a useful adjunct to teaching program evaluation.